Status of SG38

Presented to CSEWG: Brookhaven National Laboratory

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LLNL-PRES-??????

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Outline

- How new structure effort got started
- OECD/NEA WPEC subgroup 38
  - 7 tasks (project creep)
  - Status
- FUDGE and GND

How new structure effort got started

History of evaluated formats – LLNL's ENDL

- Evaluated Nuclear Data Library
- AWE designed a format in the late 1950s
- Shared it with LLNL
  - LLNL modified it some
  - Have used it since ~1960 (~54 years old)
- Format
  - Only supports pointwise data
  - All data in lab. frame except 2-body P(μ|E)
- Only LLNL uses it
  - This has effectively isolated us from the rest of the community

LLNL needed a new format

- Around 2006 we (LLNL) started search for new format.
- Decided against ENDF
- Started design of GND
  - GND = Generalize Nuclear Data
- Took design to CSEWG ~ Nov 2011
  - Recommended we make a WPEC proposal
- Dennis McNabb made proposal to WPEC May 2012

Original proposal to WPEC by McNabb

LLNL has made an initial attempt at a new format, which can be downloaded at https://ndclx4.bnl.gov/gf/project/gnd/

- Sub-group participants will
  - Develop a common data model for reaction data
  - Agree on best practices and how to "enforce" them
  - Test things out with their local ENDF-formatted databases
  - Propose a process for dissemination and future modifications
- LLNL and USNDP is committed to seeing this through
- Benefits are significant
  - Attract and retain next generation of scientists and engineers
  - Leverage significant infrastructure that will continue to evolve
  - Overcomes limitations of existing format in an extensible way
  - Positions community to link disparate data products to each other

SG38 formed

- Title

**“Beyond the ENDF format:
A modern nuclear database structure”**

- OECD/NEA WPEC subgroup 38

- Started as a task to design a new nuclear data structure to replace ENDF6.
  - Project creep?

Schedule

- Meet every 6 months for 3 years.
- First meeting Nov. 2012.
- Tried video conferencing. This is not working in my opinion.
- Since last meeting in Dec 2014, USA has had 3 sub-meetings (sub-versive?).
  - Caleb and me to LANL. LANL to LLNL. LLNL, LANL, BNL to ORNL.
  - Need to have more of these, in my opinion. Everybody welcome.
- Next WPEC meeting this May. Last meeting Nov 2015. Will ask for one year extension.

New nuclear data structure vs. format

- SG 38 is defining a new structure for nuclear ‘reaction’ data
  - This is an outline of how the data are to be stored
- SG 38 has agreed to support an XML version of GND
  - We call XML a meta-language
- A format is a structure represented using a meta-language
  - E.g., GND/XML, GND/HDF5, GND/Python

7 SG 38 tasks – decided at first meeting – project creep?

- Low-level data containers
  - Similar to ENDF LIST, TAB1, TAB2, etc.
  - Work with other data projects (e.g., ENSDF, EXFOR, RIPL)
- Hierarchy for storing particle data and nuclear level schemes and decay data
- Top-level hierarchy for storing nuclear reaction data
- Infrastructure for data handling, processing, plotting, etc.
- API for reading and writing data in the new structure
- Defining the tests that will be needed to assure quality of data
- Documentation and governance

Outline for each task

- Develop a requirements document

- Develop a specifications document

Low-level data containers

- Low-level data containers
  - Draft requirements and specifications document written.
  - 61 pages
- Hierarchy for storing particle data and nuclear level schemes and decay data
- Top-level hierarchy for storing nuclear reaction data
- Infrastructure for data handling, processing, plotting, etc.
- API for reading and writing data in the new structure
- Defining the tests that will be needed to assure quality of data
- Documentation and governance

Low-level data containers

- Low-level data containers
- Hierarchy for storing particle data and nuclear level schemes and decay data
  - Draft requirements and specifications document written.
  - 29 pages
- Top-level hierarchy for storing nuclear reaction data
- Infrastructure for data handling, processing, plotting, etc.
- API for reading and writing data in the new structure
- Defining the tests that will be needed to assure quality of data
- Documentation and governance

Low-level data containers

- Low-level data containers
- Hierarchy for storing particle data and nuclear level schemes and decay data
- Top-level hierarchy for storing nuclear reaction data
  - Draft requirements document written.
  - ~91 pages – thank you Dave.
- Infrastructure for data handling, processing, plotting, etc.
- API for reading and writing data in the new structure
- Defining the tests that will be needed to assure quality of data
- Documentation and governance

FUDGE and GND

LLNL's infrastructure - FUDGE

- For Updating Data and Generating ENDL
- Started around 2002 to supporting managing and processing LLNL's ENDL data
- Interface written in Python
  - Has C/C++ routines for computationally intensive calculations
- Modified to support the new format (GND)
  - More modification needed as GND changes

FUDGE

- Read/write ENDL, ENDF6 and GND/XML
  - Translation between ENDF6 and GND/XML
- Modifying data
  - e.g., xSecMod = 1.2 * xSec
- Viewing data: plotting and printing
- Checking
  - Finds issues other checkers miss
  - used in BNL/NNDC's ADVANCE package
- Processing

Status of FUDGE ENDF translation to GND

- For ENDF-VII.1 sub-libraries:
  - Can translate:
    - neutrons/ protons/ deuterons/ tritons/ helium3s gammas/ standards/ electrons/ photoat/ atomic_relax/
  - Can be translated into GND-like format, these are not yet integrated with Fudge:
    - nfy/ sfy/ thermal_scatt/
  - Currently not supported:
    - Decay/
- Newest FUDGE
  - One day needed to implement a few missing features in latest “specifications”.
  - Should also handle other libraries (e.g., JEFF, JENDL) as long as the data are good.

Summary

- Low-level data containers
  - Requirements and specifications document written
- Hierarchy for storing particle data and nuclear level schemes and decay data
  - Requirements and specifications document written
- Top-level hierarchy for storing nuclear reaction data
  - Requirements document written
- Infrastructure for data handling, processing, plotting, etc.
- API for reading and writing data in the new structure
- Defining the tests that will be needed to assure quality of data
- Documentation and governance

Glad to give current documents to anyone.

Summary – cont.

- LLNL will have a working version of “GND” by Oct 1 2015.
  - We need something as ENDL is too limiting.

- FUDGE is nearly up to date with latest ‘design’.
  - Will be up to date by Oct 1 2015.
  - Additional questions to beck6@llnl.gov or mattoon1@llnl.gov

FUDGE is freely available and can be downloaded at https://ndclx4.bnl.gov/gf/project/gnd/

History of evaluated formats - ENDF

- Evaluated Nuclear Data File
- Designed in the early 1960s (~50 years old)
- Supports pointwise and parametric data type
- Data can be in lab or center-of-mass
- Obviously richer than ENDL but still has issues
  - Limits values to 11 character each
    - e.g., “-1.2345e-10”. Often written without “e” (e.g., “-1.23456-10”) to get another digit which requires special handling for all computer languages but FORTRAN
    - Punchcard form
    - Fixed particle and reaction types